

Claims

1. A method of controlling an unmanned aerial vehicle (100) from a control station (110) by means of a wireless command link (115), involving:
 - 5 flight control in an autonomous mode wherein the vehicle (100) flies according to a primary route (R1, R1') defined by a first set of predefined waypoints (WP1-WP8, IP),
 - flight control in a manual mode wherein the vehicle (100) flies according to a primary route (R1') defined by control com-
 - 10 mands received via the wireless command link (115), and
 - functional monitoring of a set of flight control parameters (P1-Pn) in both the autonomous mode and the manual mode, wherein if, in any of the modes, at least one of the flight control parameters (P1-Pn) falls outside an acceptable range a major
 - 15 alarm condition is activated, the method involves flying the vehicle (100) according to an emergency route (R2') defined by a second set of predefined waypoints (HP4, HP3, IP, TP9), **characterized by** the set of flight control parameters (P1-Pn) including at least one engine parameter, the method comprising:
 - 20 activating a major alarm condition with respect to an engine failure in case at least one of the at least one engine parameter decreases below a threshold value, and in such case,
 - the emergency route (R2') involves flying the vehicle (100) to an air space above a termination waypoint (TP1-TP9) on the
 - 25 ground at which it is estimated that the vehicle's (100) flight may be ended without injuring any personnel or causing uncontrolled material damages.
2. A method according to claim 1, **characterized by** the set of flight control parameters (P1-Pn) including a command link
 - 30 parameter, the method comprising:
 - activating a minor alarm condition with respect to a com-
 - mand link failure in case the command link (115) is interrupted during a first time interval (T1), and in such case,
 - initiating a horizontal flight of the vehicle (100).

3. A method according to claim 2, **characterized by** the method comprising:

activating a major alarm condition with respect to a command link failure in case the command link (115) is interrupted
5 during a second time interval (T2) exceeding said first time interval (T1), and in such case,

the emergency route (R2') involves flying the vehicle (100) towards a base location (130) on the ground.

4. A method according to claim 3, **characterized by** the flying
10 of the vehicle (100) towards the base location (130) involving elevating the vehicle (100) to a predetermined altitude.

5. A method according to any one of the claims 2 - 4, **characterized by**

clearing the minor alarm condition with respect to a command link failure in case the command link (115) returns before
15 expiry of the second time interval (T2), and

returning the flight control of the vehicle (100) to the mode in which the vehicle (100) was controlled before the interruption in the command link (115).

20 6. A method according to any one of the claims 2 - 5, **characterized by** in case of a major alarm condition with respect to a command link failure, the command link (115) remains interrupted during a third time interval (T3) exceeding said second time interval (T2), the emergency route (R2') involves
25 flying the vehicle (100) to an air space above a termination waypoint (TP1-TP9) on the ground at which it is estimated that the vehicle's (100) flight may be ended without injuring any personnel or causing uncontrolled material damages.

7. A method according to claim 6, **characterized by** in case
30 of a major alarm condition with respect to a command link failure, the command link (115) remains interrupted during a fourth time interval (T4) exceeding said third time interval (T3),

initiating an emergency landing of the vehicle (100) at the termination waypoint (TP1-TP9).

8. A method according to any one of the preceding claims, **characterized by** in case the command link (115) returns at any instance in time, transmitting a link status message from the vehicle (100) to the control station (110), the link status message indicating a functioning condition for the command link (115).
9. A method according to claim 8, **characterized by** after transmission of the link status message, the method involving:
enabling the vehicle (100) to receive overriding commands from the control station (110) via the command link (115),
discontinuing a flight according to the emergency route (R2') in case overriding commands are received, and in such case
enabling a flight control according to the manual mode.
10. A method according to any one of the claims 1 - 9, **characterized by** the autonomous flight control mode involving transmission of the control commands to the vehicle (100) in the form of a number of commands constituting an alternative set of waypoints (WP4').
11. A method according to any one of the claims 1 - 10, **characterized by** the manual flight control mode involving transmission of the control commands to the vehicle (100) in the form of real-time commands (WP4').
12. A method according to any one of the claims 1 - 11, **characterized by**:
selecting points from the first set of predefined waypoints (WP1-WP8, IP) from an indexed table by means of a stepwise procedure, and
selecting points from the second set of predefined way-

points (HP1-HP7, TP1-TP9, IP) by means of jumping from a first line in the indexed table to a second line in the indexed table, the second line being specified on said first line.

13. A computer program directly loadable into the internal memory of a digital computer, comprising software for accomplishing the steps of any of the claims 1 – 12 when said program is run on a computer.

14. A computer readable medium, having a program recorded thereon, where the program is to make a computer accomplish the steps of any of the claims 1 – 12.

15. An unmanned aerial vehicle (100) controllable from a control station (110) by means of a wireless command link (115) comprising

an on-board flight control system (310) including:

15 an autonomous control sub-system (311) adapted to control the vehicle to fly according to a primary route (R1) defined by a first set of predefined waypoints (WP1-WP8, IP), and

20 a manual control sub-system (312) adapted to receive commands from the control station (110) via the wireless command link (115), and control the vehicle (100) to fly according to a primary route (R1') defined by the commands from the control station (110), and

25 a functional monitoring system (320) adapted to monitor a set of flight control parameters (P1-Pn), and in case at least one of the flight control parameters (P1-Pn) falls outside an acceptable range, set a major alarm condition and initiate a flight of the vehicle (100) according to an emergency route (R2') defined by a second set of predefined waypoints (HP4, HP3, IP, TP9),

30 **characterized in that** the set of flight control parameters (P1-Pn) includes at least one engine parameter, and the functional monitoring system is adapted to, in case at least one of the at least one engine parameter decreases below a threshold value,

set an alarm condition with respect to an engine failure, and fly the vehicle (100) according to the emergency route (R2') to an air space above a termination waypoint (TP1-TP9) on the ground at which it is estimated that the vehicle's (100) flight may
 5 be ended without injuring any personnel or causing uncontrolled material damages.

16. An unmanned aerial vehicle (100) according to claim 15, **characterized in that** the functional monitoring system (320) is adapted to monitor the wireless command link (115), and in case
 10 the command link (115) is interrupted during a first time interval (T1): activate an alarm condition with respect to a minor command link failure, and
 initiate a horizontal flight of the vehicle (100).

17. An unmanned aerial vehicle (100) according to claim 16,
 15 **characterized in that** the functional monitoring system (320) is adapted to, in case the command link (115) is interrupted during a second time interval (T2) exceeding said first time interval (T1): activate a major alarm condition with respect to a command link failure, and
 20 fly the vehicle (100) towards a base location (130) on the ground.

18. An unmanned aerial vehicle according to any one of the claims 16 or 17, **characterized in that** the functional monitoring system (320) is adapted to, in case the command link (115)
 25 returns before expiry of the second time interval (T2):
 clear the alarm condition with respect to the minor command link failure, and
 return the flight control of the vehicle (100) to the control sub-system which controlled the vehicle (100) before the
 30 interruption in the command link (115).

19. An unmanned aerial vehicle according to any one of the claims 17 or 18, **characterized in that** the functional monitoring

system (320) is adapted to, in case of a major alarm condition with respect to a command link failure, the command link (115) remains interrupted during a third time interval (T3) exceeding said second time interval (T2), fly the vehicle (100) to an air space above a termination waypoint (TP1-TP9) on the ground at which it is estimated that the vehicle's (100) flight may be ended without injuring any personnel or causing uncontrolled material damages.

20. An unmanned aerial vehicle (100) according to any one of the claims 17 - 19, **characterized in that** the functional monitoring system (320) is adapted to initiate a landing of the vehicle (100) at the termination waypoint (TP1-TP9), if at the expiry of a fourth time interval (T4) after that the command link failure occurred, the command link failure remains; the fourth time interval (T4) exceeding said third time interval (T3).

21. An unmanned aerial vehicle (100) according to any one of the claims 16 - 20, **characterized in that** the functional monitoring system (320) is adapted to, in case the command link (115) returns at any instance in time, generate a link status message indicating a functioning condition for the command link (115).

22. An unmanned aerial vehicle (100) according to claim 21, **characterized in that** the functional monitoring system (320) is adapted to, after that the link status message has been transmitted to the control station:

enable the vehicle (100) to receive overriding commands from the control station (110) via the command link (115),
discontinue a flight according to the emergency route (R2') in case overriding commands are received, and in such case enable activation of the manual control sub-system (312).